CUMENTATION PAGE

Form Approved
OMB No 0704-0188

2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
10/15/1992	Final, September 1, 89 - August 31, 92

4. TITLE AND SUBTITLE

Laser Excitation and Chemi-ionization of Combustion Species

5. FUNDING NUMBERS

DAAL03-89-G-0099

6. AUTHOR(S)

Vikram S. Kushawaha

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Howard University
2400 Sixth St., NW
DC 20059

8. PERFORMING ORGANIZATION REPORT NUMBER

None

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U. S. Army Research Office
P. O. Box 12211
Research Triangle Park, NC 27709-2211

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

ARO 27030.11-CH-SAH

11. SUPPLEMENTARY NOTES

The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

During the tenure of the project, we have studied the ion-molecule reactions involving collisions of low energy CHO^+ ions and CH_4, H_2, N_2 and O_2, etc. molecules. Several electronically excited states have been identified and the reaction rate coefficients have been measured for the strongest band(s) of the excited state molecules or radicals and the atomic lines. We have also extensively studied the Stimulated Raman scattering processes in a wide and capillary tubings and have measured the efficiency of scattered laser lines at various wavelengths in CH_4 and H_2 as gain media. These experiments were performed at high pressures of these gases (100 - 500 PSI) and high pump energy (1-100 mJ) of the third harmonic of the Nd:YAG laser laser. Our results indicate that the capillary tubing is slightly more efficient that the wide bore tubing and a compact Raman laser source may be built for scientific research. In addition, we have studied the competition between the stimulated Raman and Brillouin scattering processes and calculated the corresponding gain coefficents. During the studies of the scattering processes, we have observed the two photon excitation and dissociation of CH_4 and H_2 molecules using the third harmonic pulsed laser line at 355 nm from Nd:YAG. The photodissociative excitation of CH-radicals and H-atomic lines may be used for diagnostic purposes of the unburnt methane and hydrogen gases in combustion flames

14. SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

HOWARD UNIVERSITY
WASHINGTON DC 20059

1. ARO PROPOSAL NUMBER: 27030-CH-SAH

2. PERIOD COVERED BY REPORT: 1 September 89 - 31 August 1992

3. TITLE OF PROPOSAL: Laser Excitation and Chemi-ionization of combustion Species

4. CONTRACT OR GRANT NO.: DAAL03-89-0099

5. NAME OF THE INSTITUTION: Howard University

6. AUTHOR OF THE REPORT: Vikram S. Kushawaha

7. LIST OF MANUSCRIPTS SUBMITTED OR PUBLISHED UNDER ARO SPONSORSHIP DURING THIS REPORTING PERIOD, INCLUDING JOURNAL REFERENCES:

1. Chemiluminescenct ..... CHO^+ Ions and CH_4 Molecules
A. Michael, P. Misra, and V. Kushawaha
Appl. Spectroscopy, 46, 797, 1992.

2. Laser Wavelength, Pressure..... Gain in H_2
K. Sentrayan, L. Major, H. Bryant, A. Michael, and V. Kushawaha
Spectry. Lett. 25, 627, 1992.

3. Electronic Emission due .....CHO^+ and H_2^+ Ions and CH_4 and N_2 Molecules
A. Michael, P. Misra, ans V. Kushawaha
J. Phys. B 25, 2343, 1992.

4. Liquid Nitrogen and Room Temperature..... Isotopic Molecules
K. sentrayan, L. Major, A. Michael, and V. Kushawaha
J. Phys. D (Appl. Phys.) (Accepted, 1992)

5. Stimulated Raman ... in Capillary Cell
H. Bryant, K. Sntrayan, and V. Kushawaha
Spect. Lett. (In Press, 1992)

6. Intense Backward SRS-Lasers in H_2 and CH_4
K. Sentrayan, A. Michael, and V. Kushawaha
Appl. Opt. (Accepted, 1992)

7. Observation of Stokes and anti-Stokes.... Nd:YAG laser
K. Sentrayan, L. Major, A. Michael, and V. Kushawaha
Appl. Phys. B (Accepted, 1992)

8. Competition between Stimulated Raman and Brillouin Scattering in CH_4 and H_2

K. Sentrayan and V. Kushawaha
J. Phys. D (Appl. Phys.) (Submitted, 1992)

8. SCIENTIFIC PERSONNEL SUPPORTED BY THIS PROJECT AND DEGREES AWARDED DURING THIS REPORTING PERIOD:

1. A. Michael
2. L. Major,
3. K. Sentrayan
4. A. Farah
5. H. Bryant

Degree awarded: 1. One M.S. Degree, 2. One Ph.D. Thesis is in the process of being written.

9. REPORT OF INVESTIGATIONS (BY TITLE ONLY): None

10.BRIEF OUTLINE OF RESEARCH FINDINGS:

During the tenure of the project, we have studied the ion-molecule reactions involving collisions of low energy CHO^+ ions and CH_4, H_2, N_2 and O_2, etc. molecules. Several electronically excited states have been identified and the reaction rate coefficients have been measured for the strongest band(s) of the excited state molecules or radicals and the atomic lines. We have also extensively studied the Stimulated Raman scattering processes in a wide and capillary tubings and have measured the efficiency of scattered laser lines at various wavelengths in CH_4 and H_2 as gain media. These experiments were performed at high pressures of these gases (100 - 500 PSI) and high pump energy (1-100 mJ) of the third harmonic of the Nd:YAG laser laser. Our results indicate that the capillary tubing is slightly more efficient that the wide bore tubing and a compact Raman laser source may be built for scientific research. In addition, we have studied the competition between the stimulated Raman and Brillouin scattering processes and calculated the corresponding gain coefficents. During the studies of the scattering processes, we have observed the two photon excitation and dissociation of CH_4 and H_2 molecules using the third harmonic pulsed laser line at 355 nm from Nd:YAG. The photodissociative excitation of CH-radicals and H-atomic lines may be used for diagnostic purposes of the unburnt methane and hydrogen gases in combustion flames. These results have either been published or submitted for publication in various journals.